

# NATIONAL MFE COMPUTER CENTER



## THE MFECC BUFFER

The National Magnetic Fusion Energy Computer Center Newsletter  
Lawrence Livermore Laboratory, Livermore Ca. 94550

FAMILY DAY ..... September 1977

# NMFECC OPEN HOUSE EVENTS AND DISPLAYS

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## NMFECC - PEOPLE AND MACHINES

- A PHOTOGRAPHIC COLLAGE THAT ILLUSTRATES THE SPIRIT OF THE NATIONAL MAGNETIC FUSION ENERGY COMPUTER CENTER IS PRESENTED IN ROOM 170 OF BUILDING 219.
- YOU MAY VIEW THE COMPUTERS ALL DAY IN BUILDING 117.

## MOVIES

- INTRODUCTION TO THE NATIONAL MFE COMPUTER CENTER
- COMPUTER-GENERATED FILMS ABOUT MAGNETIC FUSION
- SCHEDULE - BUILDING 219, ROOM 163:

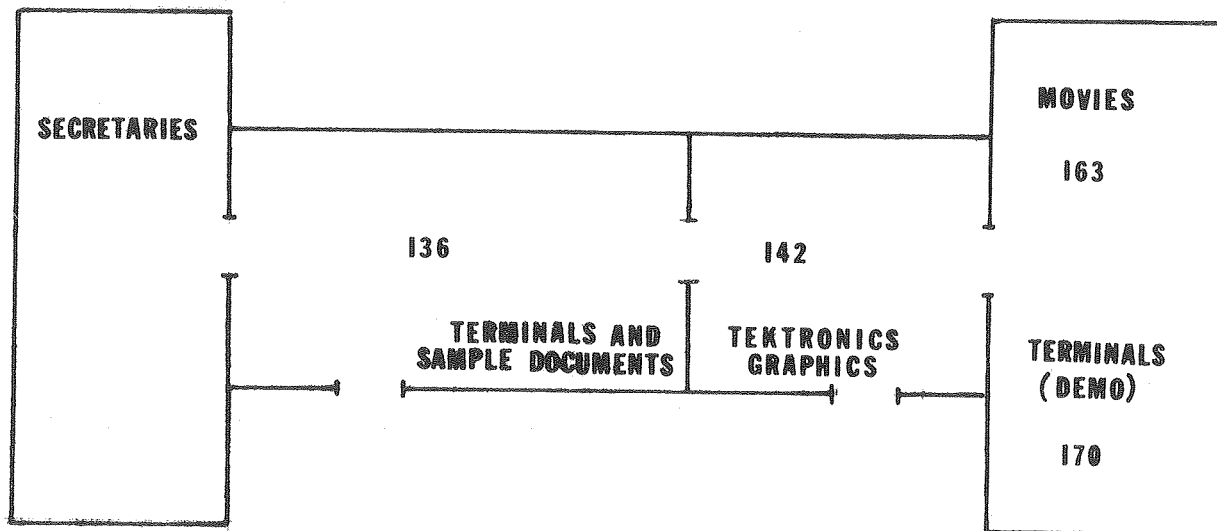
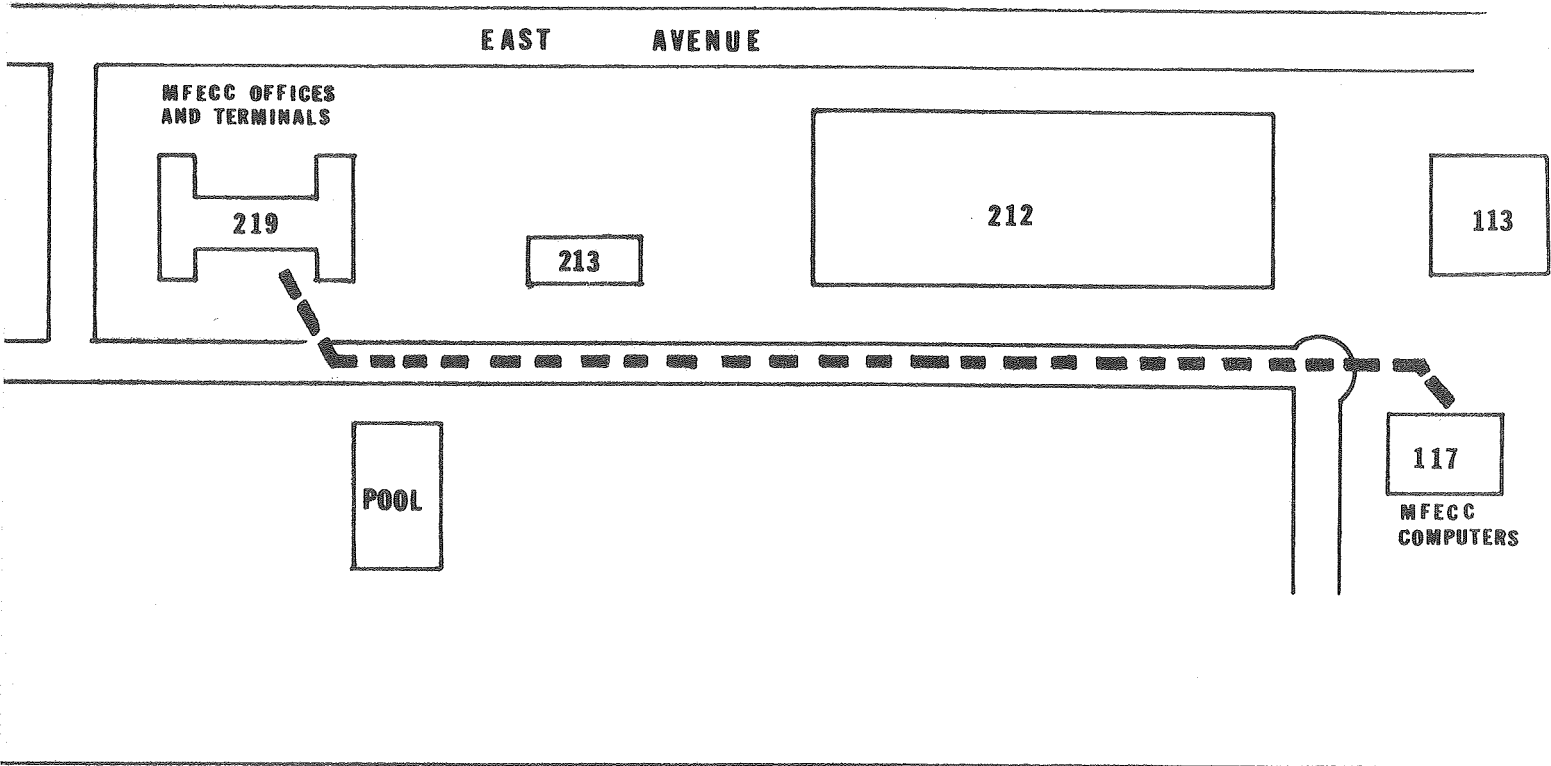
<u>A. M.</u>	<u>P. M.</u>
10:30	1:00
11:30	2:00
	3:00

## INTERACTION WITH MFENET - GAMES AND NETWORK USAGE

- TERMINALS ARE AVAILABLE IN BUILDING 219 ROOMS 136 (ONLINE DOCUMENTATION AREA) AND 170 TO ALLOW YOU TO EXPERIENCE USING THE DEC-10 AND THE CDC 7600 (A) MACHINES ON THE MFE NETWORK. INSTRUCTIONS ARE PROVIDED NEAR THE TERMINAL FOR PLAYING GAMES AND FOR USING THE NETWORK AS THE PHYSICISTS DO. SAMPLE MFENET DOCUMENTS ARE ON DISPLAY IN ROOM 136.

## COMPUTER GRAPHICS

- YOU MAY ASK THE (CDC 7600) COMPUTER TO DRAW A PICTURE ON THE TEKTRONICS CRT TERMINAL IN BUILDING 219, ROOM 142. YOU MAY ALSO PRINT YOUR PICTURE ON THE VERSATEC PRINTER/PLOTTER NEAR THE TERMINAL.



**BUILDING 219**

## THE MFE COMPUTER CENTER USERS

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In October, 1975 the MFE Computer Network consisted of 15 user groups with a total of 227 assigned users. Today, nearly two years later, there are 32 user groups with 683 assigned users. The network stretches across the country reaching 13 states, with user groups in national laboratories, universities, and industry. Here is a list of MFE Computer Center Users:

### User Service Centers

General Atomic	San Diego, California
Lawrence Livermore Laboratory	Livermore, California
Los Alamos Scientific Laboratory	Los Alamos, New Mexico
MFE Computer Center	Livermore, California
Oak Ridge National Laboratory	Oak Ridge, Tennessee
Princeton Plasma Physics Laboratory	Princeton, New Jersey
Science Applications, Inc.	La Jolla, California

### Other User Groups

Argonne National Laboratory	Argonne, Illinois
Brookhaven National Laboratory	Upton, New York
Columbia University	New York, New York
Cornell University	Ithaca, New York
General Electric Corp.	Schenectady, New York
I.N.E.S.C.O. Inc.	Arlington, Virginia
Lawrence Berkeley Laboratory	Berkeley, California
Massachusetts Institute of Technology	Cambridge, Massachusetts
Mathematical Sciences Northwest	Belleve, Washington
Naval REsearch Laboratory	Washington, D.C.
New York University	New York, New York
Northwestern University	Evanston, Illinois
Stanford Research Institute	Menlo Park, California
Stanford University	Stanford, California
University of California, Berkeley	Berkeley, California
University of California, Irvine	Irvine, California
University of California, Los Angeles	Los Angeles, California
University of Illinois	Urbana, Illinois
University of Iowa	Iowa City, Iowa
University of Maryland	College Park, Maryland
University of Texas	Austin, Texas
University of Washington	Seattle, Washington
University of Wisconsin	Madison, Wisconsin
U.S.E.R.D.A.	Washington, D.C.
Westinghouse Electric Corp.	Pittsburgh, Pennsylvania

-Anita Scott

# ADVANCED ENERGY SYSTEMS

## NATIONAL MFE COMPUTER CENTER: 1976 UPDATE

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The national magnetic-fusion-energy (MFE) computer center at Livermore, operational since the fall of 1974, expanded its data communication network and improved its software and hardware during 1976. The network now includes seven user service centers across the country (including two at LLL) connected by 50 000-bit/s transmission lines to the MFE center. The most recent addition is a service center at Science Applications, Inc. in La Jolla, California. Among the major developments this past year is a high-speed channel that standardizes the process of interfacing computers of various manufacturers. FILEM, a versatile file-management system for remote users, was also significantly improved and will include a 500-billion-bit mass storage facility later this year. Demand for computational support in the MFE community continues to outstrip the center's capacity, requiring us to plan for a second CDC 7600 at Livermore and spurring interest in a next-generation computer as a third processing unit.

In 1974, LLL was selected as the site for a national magnetic-fusion-energy computer center (MFECC). Computational studies at the center were to be keyed to the research needs of the three principal MFE confinement schemes: low-density closed systems (mainly tokamaks), high- $\beta$  systems (mainly the theta pinch), and open systems (magnetic mirrors). Major MFE research sites and scientists at universities with ERDA-sponsored MFE projects were to have access to the national center.

In the fall of 1974, the center went online to users via voice-grade telephone lines with a CDC 6600 as the central computer and a remote job entry terminal at the Princeton Plasma Physics Laboratory. One year later, a CDC 7600 replaced the 6600, inaugurating large-scale computational support to the MFE community. High-speed (50 000-bit/s) transmission lines were operational by mid-1976 to four user service centers: Los Alamos Scientific Laboratory, Princeton Plasma Physics Laboratory, Oak Ridge National Laboratory, and General Atomic Co., San Diego, California. The advent of these transmission lines

marked the start of a national wideband communications network.

The idea behind a national MFE computer center is to provide large-scale computer capability in addition to local capability at various remote locations according to research priorities and anticipated computational demand. The CDC 7600 central computer, available to the entire MFE community, has 64 000 words of small semiconductor memory, 500 000 words of large-core memory, and disk storage. The national center also has a PDP-11/50 central communications control processor, a PDP-11/50 network control station, and a CDC 6400 file management computer that stores files and maintains indices for information retrieval.

The user service centers have PDP-10 computers systems with direct high-speed access to the national center through PDP-11/40 remote communications control processors. Seven service centers are now operational: one for the MFE program at LLL, one at the MFE computer center, and one each at Princeton, Oak Ridge, LASL, General Atomic, and Science Applications Inc. (SAI), La Jolla, California. The SAI service center, our latest addition, is connected to the 50 000-bit/s transmission line that terminates at General Atomic.

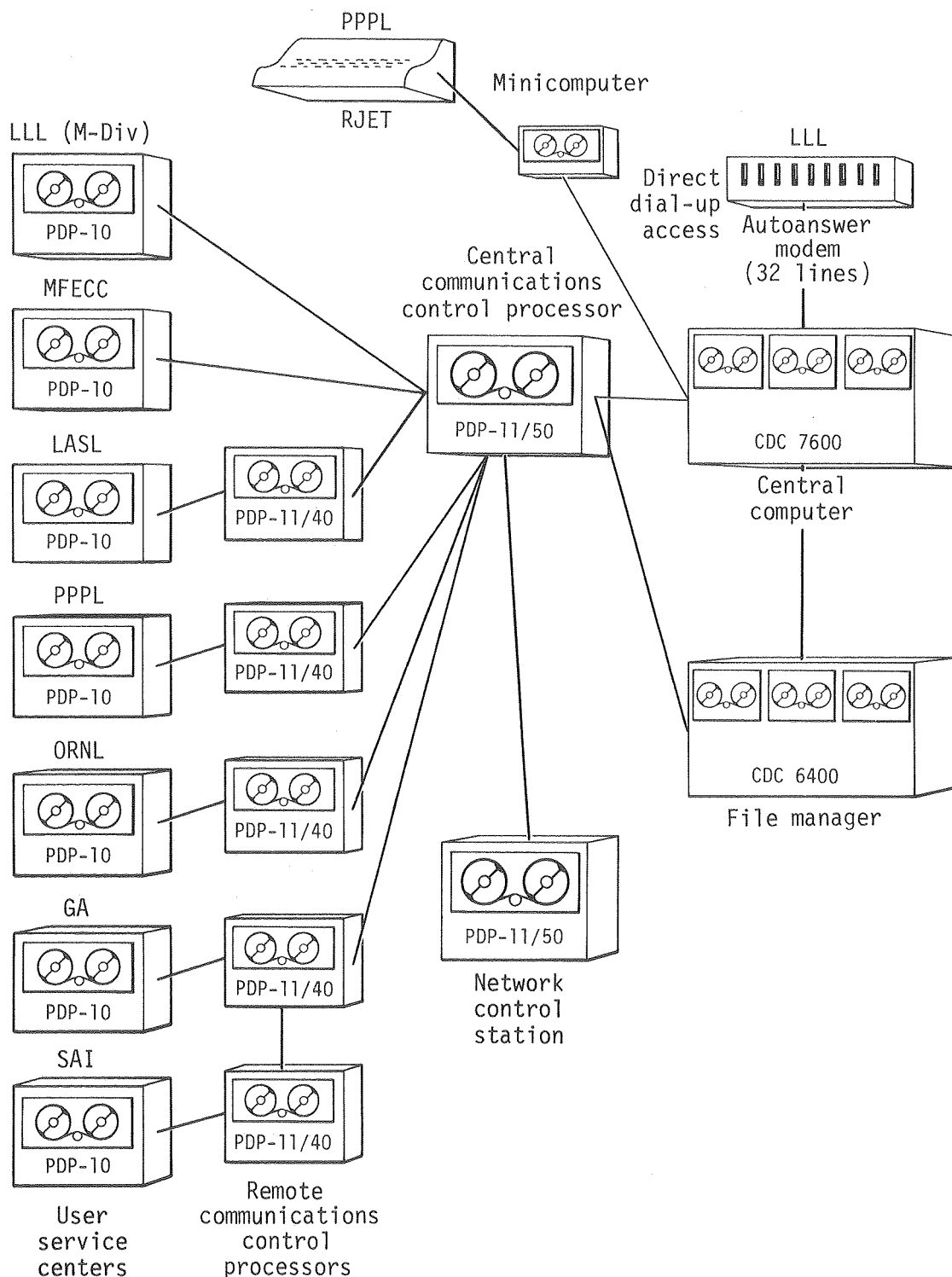
Small computation problems are handled locally at the user service centers. Large-scale problems are routed to the national center and then returned to the service centers for final processing. For offnet users, the ultimate intent is to provide either mini-service centers or remote job entry terminals. Access for these users to the national center is currently via leased telephone lines. Figure 14 shows the present configuration of the MFE computer network.

### 1976 Update

At the time of our initial article on the computer center in December 1975,<sup>12</sup> user access to the CDC 7600 was via dial-up voice-grade lines, and the 50 000-bit/s lines were in the process of being installed and checked out. Even at this early stage it was evident that the forecasts of MFE demand for large-scale computing were not exaggerated. With the help of the center's programming staff, users quickly converted their codes for operation on the national system, and

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**Fig. 14.** General arrangement and connections between user service centers and the national MFE computer center (MFECC). The network includes seven user service centers: two at LLL (one for the MFE program and one at the computer center), and one each at Los Alamos Scientific Laboratory (LASL), Princeton Plasma Physics Laboratory (PPPL), Oak Ridge National Laboratory (ORNL), General Atomic (GA), and Science Applications Inc. (SAI). Princeton also has a remote job entry terminal (RJET). A 32-line autoanswer modem (shown at upper right) provides offnet users with voice-grade dial-up access to the central computer facilities. All unshaded equipment is part of the central computing facility at Livermore.

the capacity of the 7600-A machine was saturated early in 1976.

During this past year, we have concentrated on software and hardware refinements of the central computing system at Livermore and on developing improved user access via the data communication network.

**Software and Hardware.** In February, the capability of the CDC 7600 was enhanced by installing four high-performance CDC 819 disk drives and associated controllers. Software and hardware integration of these units into the system was accomplished to permit their use in early March.

Another need recognized early by the center's staff was a standardized high-speed channel (10 to 40 million bits/s) to be used for interprocessor communication. A large computer center needs to interconnect many varieties of computers of different manufacturers and models. Interconnecting channels

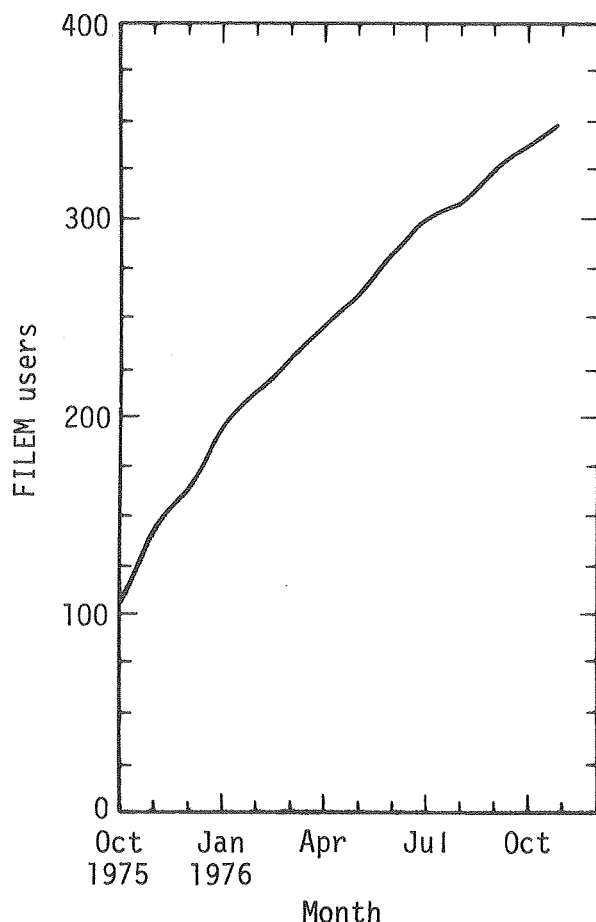
are sometimes available between models of the same manufacturer but rarely between competitors' models, such as a CDC 6400 and a DEC PDP-11. At best, one would end up with a large array of interconnecting channels, each unique and incompatible with the others, with special designs required when no channel was available. Standardization would replace this with channels that allow total freedom of choice of interconnected computer pairs and could be structured to minimize custom hardware and software design.

A computer standard interface channel for computer intercommunication has been designed. Interfaces currently nearing completion include those for a CDC 7600, CDC 6400, DEC PDP-10, and DEC PDP-11. The interface channels will connect any of these machines to any other. Additionally, an interface to an HP 2100 minicomputer has been designed to allow connection to the LLL M-Division PDP-10, which will also have the standard channel interface.

**Data Communication Network.** The ability to move files (first alpha-numeric, next graphic, and then binary) from the CDC 7600 to our user service centers through the 50 000-bit/s transmission lines was accomplished in March and April. In May we inaugurated input file traffic from the service centers to the 7600, and in July we implemented file traffic between service centers. Interactive terminal traffic over the transmission lines became operational in September. Interactive terminal access for nearly all sites not served by a user service center has remained available via autoanswer modem, which handles 28 dial-up users at 300 bits/s and 4 users at 1200 bits/s.

Development continued this past year on FILEM, a highly versatile file-management system that allows remote users to store and retrieve programs and data files at Livermore for an indefinite time. FILEM was designed to accommodate the special needs of users at remote sites, and the system has enjoyed excellent customer acceptance (Fig. 15). To enhance the FILEM system, we also selected a 500-billion-bit mass storage facility — Control Data model 38500 — which was approved by ERDA in August; estimated delivery of the storage facility is December 1977.

Currently FILEM uses rotating storage (CDC 844 disk packs) for medium-term file storage. When the mass storage facility is online, a file to be stored will be transferred to the facility with a copy also written onto the FILEM disk system for short-term rapid access. The urgent need for such a system has required the computer center to temporarily simulate the mass storage facility by transferring the data onto



**Fig. 15.** Growth in user demand for central file storage in FILEM, a versatile file-management system enabling remote users to store and retrieve programs and files at the MFE computer center.

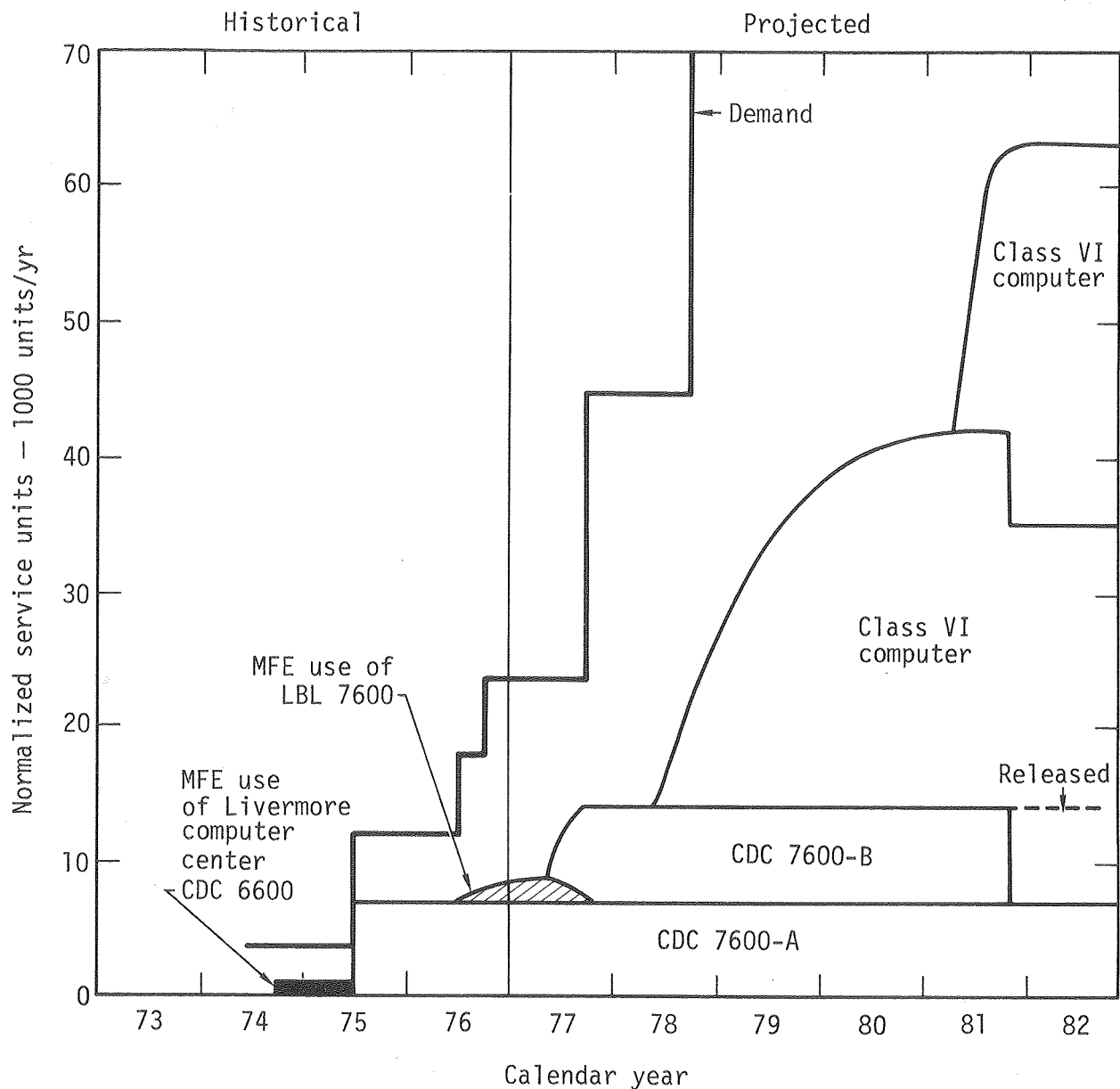


Fig. 16. Projected demand and anticipated hardware needed to keep pace with that demand at the MFE computer center. Projected demand comes from a 1976 survey in which users were asked to estimate their requirements by fiscal years. Immediate plans call for adding another CDC 7600 in 1977. We are also studying the possibility of adding a class VI (next-generation) computer as a third central processing unit in 1978.

conventional magnetic tape. However, these tapes must be manually retrieved, mounted, demounted, indexed, and stored.

A FILEM software effort under way during the past year has been programming the CDC 6400 to assume virtually all of the tasks associated with file custodianship, including indexing, storage, retrieval, and efficient management and allocation of the file storage media.

#### Future Growth

The immediate problem facing the MFE computer center is that the ever-increasing demand for more computing time has oversubscribed the capacity of a single 7600. We need at least one more 7600 and are also planning to add a class VI (next-generation) processor as a third major central processing unit in FY 1978. As an interim stop-gap measure, the center is currently acquiring blocks of computer time from



the 7600 at the Lawrence Berkeley Laboratory for MFE users. Figure 16 shows anticipated future computational demand for the computer center.

A related development this year was establishing the design criteria and selecting an architect-engineering firm for our new \$5 million computer facility. Construction is scheduled to begin in October 1977;

complete occupancy is slated for December 1978. The 3700-m<sup>2</sup> facility is designed to accommodate three major computing mainframes and offices for about 87 people, including center staff and visitors.

*Key Words: fusion research; MFECC; magnetic fusion energy.*